



**COMMERCIAL SERVICES ASSESSMENT**

**PUBLIC SAFETY  
WIRELESS NETWORK (PSWN)  
PROGRAM MANAGEMENT OFFICE**

Fairfax, Virginia  
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**BOOZ·ALLEN & HAMILTON**

Foreword...

**PUBLIC SAFETY AGENCIES RELY HEAVILY ON THEIR PRIVATE LAND MOBILE RADIO (LMR) NETWORKS BUT ALSO USE COMMERCIAL WIRELESS SERVICES**

- The expansion of commercial wireless service offerings provides an opportunity to examine these services as potential cost-effective alternatives or adjuncts to privately owned networks
- In support of the Public Safety Wireless Network (PSWN) Program Management Office (PMO), Booz•Allen & Hamilton analyzed Nextel commercial wireless services and assessed their current or future role in the public safety communications architecture
  - This report is not intended to reflect a government position or endorse the service
  - We invite comments to ensure the most current information is included in our analysis
  - If you have comments regarding the information contained in this document, please contact the PSWN PMO at 800-565-PSWN or access the PSWN Program Home Page at: [www.pswn.gov](http://www.pswn.gov)
- Booz•Allen relied on several sources of information for the report
  - Industry literature
  - Interviews with Nextel and Motorola
  - Interviews with public safety representatives

## I. INTRODUCTION

Introduction...

**THE REPORT HIGHLIGHTS IMPORTANT ASPECTS OF NEXTEL, PARTICULARLY ITS SERVICES AND NETWORKS, AND PROVIDES AN ANALYSIS OF HOW THE PUBLIC SAFETY COMMUNITY IS CURRENTLY USING NEXTEL'S SERVICES TO PERFORM THEIR MISSION**

- Section II provides an overview of Nextel and its services
  - Market position
  - History
  - Service Offerings
  - Service Costs
  - Distribution
  - Availability
  - Joint Ventures
  - Corporate Profile
- Section III provides an overview of Nextel's networks
  - Build-Out
  - Architecture
  - Reliability
  - Privacy
  - Advanced Features Not Deployed
- Section IV discusses the public safety communities use of Nextel services
  - What types of organizations are using Nextel
  - What missions are being supported
  - Observations/perceptions of Nextel
- Section V provides a summary and conclusions regarding Nextel and its use by public safety organizations
- Appendix A provides a detailed description of Nextel's network architecture
  - iDEN System Elements
  - Call processing

## II. NEXTEL OVERVIEW

## **NEXTEL OFFERS ANALOG AND DIGITAL SPECIALIZED MOBILE RADIO (SMR) SERVICES**

- SMR is a commercial, for-profit wireless service that primarily provides businesses with mobile dispatch communications
  - Dispatch communications are one-to-one or one-to-many messages
  - In 1974, the Federal Communications Commission (FCC) created SMR at the same time as cellular telephony
  - The first SMR system in the United States became operational in 1977
  - According to the Strategis Group, more than three million SMR subscribers exist in the United States, most of whom are part of the services, construction, and transportation industries
- Demand for more enhanced and bundled services and features such as paging, interconnection with the public switched telephone network (PSTN), and mobile data transmission has led to the development and deployment of more sophisticated digital SMR technology
  - Nextel is one of only a few large SMR operators rolling out wide-area systems using digital technology and multisite, cellular-like architectures
  - Nextel's digital network relies on a wide-area SMR technology referred to as Enhanced Specialized Mobile Radio (ESMR), which is based on Motorola's Integrated Dispatch Enhanced Network (iDEN) technology
  - Nextel's digital services are offered in the 800 MHz range only; it's analog services are offered in both the 800 and 900 MHz ranges
- By taking advantage of FCC rulings allowing SMR operators to assemble nationwide systems, Nextel is rapidly implementing a digital network that will be available nationwide and will allow the company to compete with cellular and personal communication services (PCS) operators

## **NEXTEL WAS FOUNDED IN 1987 UNDER THE ORIGINAL NAME OF FLEETCALL**

- The company has grown significantly through the merger and acquisition of several SMR providers and other related assets
- The following is a list of several major acquisitions or mergers:
  - In July 1994, Nextel merged with OneComm, creating a company capable of providing service in all of the top 50 U.S. markets
  - In August 1994, Nextel merged with Questar Telecom Inc, acquiring ownership of SMR licenses in California and Nevada
  - In August 1994, Motorola acquired 22% of Nextel in exchange for its 800 MHz licenses and related businesses in the United States; the deal was worth \$450 million
  - In February 1995, Nextel agreed to a tax-free stock merger with Dial Call, the leading SMR provider in the southeast United States, worth \$650 million
  - In 1995, Nextel issued 4.2 million shares of common stock for all the remaining shares of American Mobile Systems (AMS)
  - In December 1996, Nextel acquired 6,000 800 MHz channels from Pittencrieff Communications Inc (PCI)
- In recent years, Nextel's management structure has undergone significant change and is committed to overhauling its network technology, reorganizing its operations and infrastructure, and introducing new product offerings
  - In April 1995, cellular pioneer Craig McCaw acquired approximately 26 percent of Nextel for a reported \$1.1 billion and is an active Board of Directors member
  - In January 1996, Timothy Donahue, a former McCaw Cellular/ AT&T Wireless Services executive, became President and Chief Operating Officer of Nextel
  - One month later, Daniel Akerson, former president of MCI, joined as Nextel's Chief Executive Officer

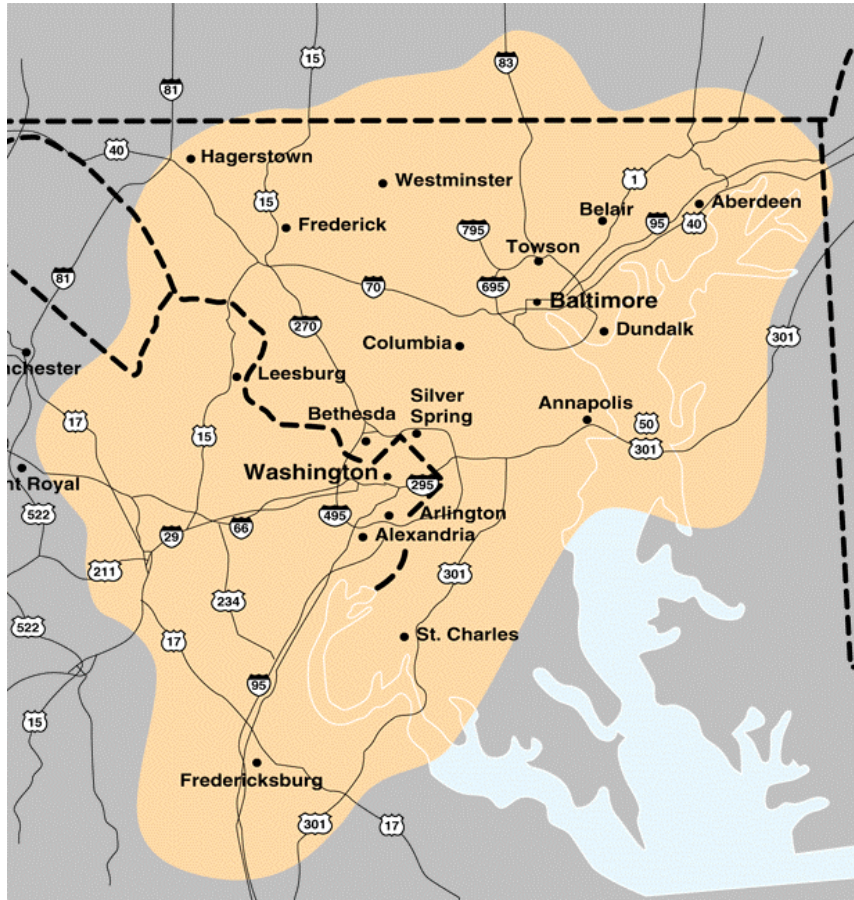
**NEXTEL DIFFERENTIATES ITSELF FROM OTHER COMMERCIAL WIRELESS SERVICES BY PROVIDING CELLULAR PHONE SERVICE, PRIVATE AND GROUP DISPATCH, AND ALPHANUMERIC TEXT MESSAGING THROUGH ONE HANDSET**

- The company does not offer mobile data services but plans to within the next two years
- Users are responsible for purchasing or leasing end-user equipment, which are typically portable radios
  - Nextel does not offer a leasing option on end-user equipment, but leasing arrangements do exist through indirect dealers and agents
  - The facing page shows three sample phones—i600, r370, and Lingo 3000
  - The i600 is Nextel's smallest and feature-rich phone; it costs approximately \$229
  - The r370 is a compact but rugged phone manufactured to meet Military Standard 810 C/D/E environmental specifications; the phone is priced by Nextel at \$349
  - The Lingo 3000 is a larger handset compared to the i600 or r370 and costs \$629
- A wide variety of radios and accessories are available through Nextel or other wireless services dealers
  - Handsfree car kit
  - NiCd, NiMH, Li-ION batteries
  - Remote speaker microphone
  - Desktop and vehicle chargers
  - Handsfree earpiece kit
  - Various leather and nylon cases
  - Data and VBC cable
- Motorola and competing manufacturers who are licensed by Motorola will be the only manufacturers of subscriber equipment that is compatible with Nextel's digital network
  - Motorola has agreed to license at least one alternative manufacturer of iDEN infrastructure equipment
  - Currently, however, no arrangements exist with any additional manufacturers to supply Nextel with an alternative source for either iDEN system infrastructure or subscriber equipment



**NEXTEL SERVICES ARE OFFERED WITHIN AND BETWEEN SERVICE AREAS THAT COVER LARGE GEOGRAPHIC AREAS AS ILLUSTRATED IN THE FOLLOWING TWO EXAMPLES**

## BALTIMORE/WASHINGTON SERVICE AREA



Source: Nextel

## PHOENIX/TUCSON SERVICE AREA



## **NEXTEL'S CELLULAR TELEPHONE SERVICE OPERATES SIMILAR TO CELLULAR OR PCS WIRELESS SERVICES**

- Each subscriber is assigned a 10-digit phone number based upon the North American Numbering Plan
  - Subscriber location and routes are tracked by the network
  - Hand-off capabilities between antenna sites provide seamless communications
  - Outgoing calls are made by entering a number then pressing the "SEND" button
  - Incoming calls are answered by pressing the "SEND" or "PHONE" button
  
- Nextel offers a number of additional features associated with its interconnected service
  - Voicemail                      - Call hold
  - Call waiting                - No-answer or busy-signal transfer
  - Call forwarding           - Three-way conference calling
  - Two lines
  
- The cellular service is operational in any Nextel service area, and Nextel users are not required to perform any additional operating steps with the handsets when they are outside their home service area
  
- Nextel plans to own and operate a nationwide digital network; therefore, it does not have any roaming or interoperability agreements with any other wireless service provider in the United States

**THE DISPATCH SERVICE, A PUSH-TO-TALK SERVICE SIMILAR TO LAND MOBILE RADIO, IS MARKETING OR REFERRED TO AS “DIRECT CONNECT”**

- The Direct Connect service enables subscribers to set up a conference on either a Private Call (i.e., one-to-one) or Group Call (i.e., one-to-many) basis
  - These groups are generally referred to as talkgroups
  - Nextel subscribers can establish up to as many as 100 Private Call entries, depending on model of the phone
  - The Direct Connect service is operable only within a user's home service area, but Nextel plans to enhance its networks to allow a subscriber to use the service between service areas
- A Private Call is made by depressing the “Mode” button on the phone and selecting the “Prvt Ready” function
  - A list of preprogrammable names of users can be scrolled using the arrow keys to select the intended recipient or the user can manually enter the intended recipient's phone ID number
  - The user must press the push-to-talk (PTT) button on the side of the phone, wait for a chirp that indicates connection, and then speak into the mouthpiece
  - The user must release the PTT to listen
- When receiving a Private Call, a user will hear a single alert tone, the name or number of the caller will be displayed, and the call will start
- A Group Call is made by depressing the “Mode” button to select the “Group Ready” function
  - The user then must scroll through a list of preprogrammed talkgroups or manually enter the talk group number
  - The user then presses the PTT button, waits for the chirp, and can begin talking
- Nextel offers Business Net Services that expand the Direct Connect concept to groups of users in a particular service area that are within a single industry or interest group (e.g., construction network)

**THERE ARE SEVERAL STEPS ASSOCIATED WITH THE ESTABLISHMENT AND MAINTENANCE OF DIRECT CONNECT TALK GROUPS AND PRIVATE CALL GROUPS**

- Nextel customers contact a Nextel sales representative or distributor to establish a banner account, in which each subscriber unit's Private ID and Talk Group ID will reside
- The customer account is assigned a fleet number and registered in the Nextel network along with the name of the user under the banner account
  - The customer informs Nextel of their desired talk group structure
  - Up to 255 talk groups can be established under one banner account
  - Nextel customers cannot configure their own talk groups
  - Additions or deletions of users, talk groups, or phone units (e.g., lost or stolen phones) must be made through Nextel
- Users and talk groups are established through one Nextel point of contact to help prevent outside users from being able to join a talk group
- The time required to establish a new talkgroup or change the structure of an existing talkgroup depends on the complexity of the request, but it usually can be completed the same day the request has been made
- Nextel Organizer™ is a software package that facilitates the organization and display of talkgroups at the user-level by enabling individual and talkgroup names to be programmed into each phone
  - The software is compatible with Windows 3.1, Windows for Workgroups or Windows 95
  - The software package includes disks, manual, and cable to connect the phone to a PC
  - Nextel Organizer™ costs \$59.95

## **ALPHANUMERIC MESSAGES CAN BE SENT TO NEXTEL SUBSCRIBERS VIA PERSONAL COMPUTERS OR OTHER SERVICES**

- Users can receive messages if they are in a Nextel service area
- NexNote™ and NexNote Plus™ are software packages used for sending text messages from a personal computer with a modem
  - The facing page illustrates the features of each service
  - These messaging software packages are priced at \$15 and \$50 for NexNote and NexNote Plus, respectively
- There are four other methods for sending text messages or numeric pages to a Nextel customer:
  - NEXGRAM is an operator-assisted messaging service which transcribes voice messages into text and sends it to Nextel handsets
  - NEXPAGE is a numeric paging service that sends a numeric page directly to Nextel handsets
  - Text messages can be sent directly from the Nextel Web site
  - Text messages can be sent from any Internet electronic mail application
- Nextel Voice Mail will store messages when the phone is off or when the user is on another call or out of range, and will then notify an available user of the message and its relative urgency
- Automatic callback is a Nextel phone feature that enables a user to quickly dial a phone number contained in a text or numeric page by simply pressing the “Send” key

**THE COST FOR THESE SERVICES VARIES IN EACH MARKET AND LARGELY DEPENDS ON THE CELLULAR AND DIRECT CONNECT MINUTES INCLUDED IN VARIOUS SERVICE PLANS**

- The facing page is a sample of Nextel's rates in Washington, D.C, Atlanta, and Los Angeles
- Customers are billed according to several principles
  - No roaming and access fees are charged between service areas
  - Once a user surpasses the plan's threshold of included-minutes, a flat per-minute rate is charged
  - When customers travel anywhere outside their service area, they are charged their home service area cellular rate
  - Customers are billed on a per-second rate for Direct Connect calls and after the first minute of a cellular call
- Billing for the Direct Connect service accounts for each user in a talk group
  - Airtime for service plans with the same number of included Direct Connect minutes is pooled at the account level
  - Call duration is timed and multiplied by the number of participants involved in the Direct Connect call
  - The call initiator is billed for the call
  - Private calls and Group calls are billed at the same per-person rate
- A fee of \$.15 per minute is charged for long distance calls in addition to the home area cellular service rate

**NEXTEL USES DIRECT AND INDIRECT DISTRIBUTION CHANNELS TO SELL ITS SERVICES AND EQUIPMENT...**

- Nextel sells directly through local corporate offices, a toll-free phone number, and its corporate Web site
- Nextel is developing an indirect dealership network through marketing agreements with companies that specialize in sales, direct marketing, and distribution
- In August 1997, Nextel signed an agreement with Brightpoint, Inc., to distribute, warehouse, and provision equipment for Nextel across the United States
  - Service providers are increasingly switching from in-house distribution to independent distribution services to lower overall costs and efficiently store and move products
  - Brightpoint is one of the largest distributors of wireless handsets and accessories in the world
    - Decentralized distribution centers
    - Several day turnaround on orders
- In October 1997, Nextel authorized four major companies to market its services and products nationwide
  - Hello Direct is a large marketer of telephone end-user equipment (e.g., headsets and wireless products)
  - BearCom is a nationwide dealer with sales representatives in 25 cities
  - TIC Enterprises, LCC is a sales and marketing firm with more than 400 sales representatives
  - Pana-Pacific manages a network of more than 1,000 dealers and distributes products from eight warehouses throughout the United States

**IT TYPICALLY TAKES 5–7 DAYS TO ESTABLISH INTIAL TALKGROUPS AND GRANT NEW PHONES ACCESS TO THE NEXTEL NETWORK**

**NEXTEL PLANS TO OFFER ITS DIGITAL SERVICES NATIONWIDE AND HAS ACQUIRED SPECTRUM TO ACHIEVE THAT GOAL**

- Nextel spent \$88.8 million to acquire 475 of the 525 licenses awarded by the FCC in an 800 MHz SMR auction in late 1997
  - On average, Nextel won rights to almost 10 MHz of spectrum in areas covering all 50 states and approximately 98 percent of the U.S. population
  - By combining frequencies formerly owned by Nextel with recently awarded frequencies, Nextel now possesses on average 15 MHz of usable spectrum in major U.S. markets and approximately 10 MHz of spectrum in the entire country
  - The auction results represent an estimated gain of 30,000 additional frequencies throughout the United States
  - On February 20, 1998, two parties filed petitions with the FCC to deny all of Nextel's applications for the licenses won in the auction
- Once the auctions proceedings are finalized, the FCC has mandated that Nextel or any license winner offer its services in each of its license areas within 3 years
- Nextel has acquired the rights to contiguous spectrum, which should increase its operating efficiencies in each service area
  - The company has committed to the deployment of iDEN networks, and efficient operation of the iDEN system requires access to a certain number of contiguous 800 MHz frequencies
  - Nextel will relocate its analog customers and incumbent licensees to alternative SMR channels
  - To facilitate the transfer, Nextel purchased 177 licenses of the 900 MHz bandwidth in the April 1996 FCC spectrum auction and will likely participate in the 800 MHz lower 200 channel auction



## **NEXTEL IS TARGETING THE INTERNATIONAL MARKET AS A KEY AREA FOR FUTURE DEMAND AND GROWTH**

- The company's strategy is to focus on under-served business and consumer markets in the developing world
  - Nextel is pursuing a strong presence in Brazil, Argentina, China, Shanghai, the Philippines, Canada, and Mexico
  - The company has roaming agreements with Clearnet Communications in Canada and Mobilcom in Mexico, allowing customers to communicate across North America
  - Nextel's wireless reach is the largest of any telecommunications company in the Western Hemisphere
- International expansion is a significant component in Nextel's strategy
  - Its most recent investment in January 1998 was the entry into a new joint venture in Peru, in which the company purchased a 70-percent interest in Valorcom S.A., known as Nextel Peru, for \$27.9 million
  - Nextel Peru is currently offering analog SMR services in the greater Lima area, but the company plans to upgrade its services to digital iDEN-based services in 1999
- Nextel now holds 100-percent equity interest in its Mexican and Argentine operating subsidiaries
  - In 1997, Nextel increased its interest in Comunicaciones Nextel de Mexico S.A. de C.V. from 30 percent to 100 percent at a cost of \$132.2 million
  - Similarly, Nextel acquired the remaining 50 percent equity interest in Nextel Argentina for \$46 million
  - Nextel Argentina also increased its total spectrum holdings to 12 MHz after it acquired 60 more SMR channels in Buenos Aires

**NEXTEL ALSO OWNS THE RIGHTS TO A SIGNIFICANT AMOUNT OF LOCAL POINT MULTIPOINT DISTRIBUTION SERVICE (LMDS) LICENSES ...**

- Nextel has entered into a joint venture with NextLink Communications, Inc., to provide LMDS
  - An LMDS system is capable of offering subscribers a range of one- and two-way broadband services, such as video programming, teleconferencing, wireless local loop telephony, and high speed data transmission (e.g., Internet access)
  - LMDS systems consist of a multicell configuration, with each cell containing a centrally located transmitter and multiple receivers
- The joint venture is being conducted through NextBand Communications, L.L.C.
- On February 18, 1998, NextBand participated in the FCC's LMDS spectrum auction of spectrum in the 28 GHz to 31 GHz range
  - As of the conclusion of the LMDS spectrum auction on March 25, 1998, NextBand had submitted \$134.7 million in bids that represented the highest bids with respect to the auction of LMDS spectrum in 42 Basic Trading Areas, covering approximately 96 million people throughout the United States
  - Under the terms of the joint venture, one-half of the bid amount will be funded by Nextel

**HOWEVER, IT IS UNCLEAR HOW OR IF NEXTEL WILL INTEGRATE ITS SMR AND LMDS SERVICES**

**NEXTEL HAS OVERCOME SIGNIFICANT FINANCIAL ISSUES AND TECHNOLOGICAL PROBLEMS RELATED TO ITS INFRASTRUCTURE EQUIPMENT**

- In late 1993, Nextel deployed the first of its digital networks in the Los Angeles area, relying on Motorola's iDEN technology for its infrastructure
  - During that time, the company experienced performance issues with respect to the iDEN system's reliability, accessibility, and voice transmission quality
  - Customers were given discounts and credits to maintain relations
  - Motorola quickly improved and reconfigured the iDEN technology, particularly the voice transmission quality
  - All of Nextel's digital networks rely on reconfigured iDEN equipment
- MCI, a key ally of Nextel's at the time, severed its business interest in the company; consequently, Nextel market valuation and financial soundness seriously suffered
- The subsequent management team of McCaw, Akerson, and Donahue has demonstrably refocused the company's direction and commitment to its business plan
- Nextel is rapidly building out its nationwide digital network and, according to the Strategis Group, is adding subscribers to its network faster than any other wireless service provider

**NEXTEL HAS NOT ACHIEVED OPERATING PROFITABILITY, BUT THE COMPANY EXPECTS TO BE PROFITABLE BY 2001**

- The nature of the wireless industry is such that substantial upfront investments in technology, spectrum acquisition, and construction are required to build a nationwide network; and advertising, marketing, and end-user equipment subsidies are needed to gain customers
- In the past year, Nextel achieved a significant expansion of its digital network and experienced a large increase in system minutes of use
  - Service availability expanded from 6 to 79 of the top 100 metropolitan statistical areas
  - Total net system minutes of use increased from approximately 94 million in January 1997 to approximately 403 million in December 1997
  - Nextel has more than 4,000 constructed sites at leased locations in the United States for its digital network; approximately 2,100 sites were placed in service in 1997 alone
  - In 1998, NEXTEL plans to spend approximately \$1.3 billion on its digital system infrastructure and add 1,800 sites
- Growth in total revenue, customer subscriber base, and average revenue per subscriber are three key indicators that will measure Nextel's performance
  - During 1997, Nextel's total revenue grew by 122 percent to \$738.9 million, up from \$332.9 million in 1996
  - As of March 31, 1998, Nextel provided service to approximately 1,641,500 digital subscribers in the United States
  - Monthly customer turnover, known as churn, is traditionally lower for SMR services than other wireless offerings; Nextel's churn was 1.3 percent in 1997 compared to the wireless industry's average of 1.9 percent
  - The monthly average revenue per digital subscriber is more than \$65
- Nextel's performance was largely attributed to the company's marketing strategy, which targeted the wireless communications needs of business and other high usage customers

### **III. NETWORK OVERVIEW**

Network Overview...

**THIS SECTION PROVIDES AN OVERVIEW OF NEXTEL'S NETWORKS**

- The section will cover the following aspects of Nextel's networks
  - Build-out
  - Architecture
  - Reliability
  - Eavesdropping Safeguards
  - Cloning Safeguards
- A more detailed and technical discussion of Nextel's network architecture and call processes is in Appendix A

**NEXTEL HAS IMPLEMENTED A BUSINESS PLAN FOCUSING ON AN ACCELERATED DEPLOYMENT OR BUILDOUT OF ITS DIGITAL NETWORK**

- Pursuant to FCC regulations, Nextel must construct and operate a sufficient number of base stations to provide coverage to at least one-third of the population of a licensed area within 3 years; the percentage climbs to two-thirds at the end of 5 years
- It takes about 4 months to complete a Nextel radio design plan
- The site acquisition process for the initial system to be constructed in a market, depending on the number of sites, typically takes from 2 to 18 months
  - Based on proximity to targeted customers
  - Ability to acquire and build the site
  - Zoning and other regulatory issues
- Preparation of each site for equipment installation, including construction of equipment shelters, towers and power systems, grounding, ventilation and air conditioning, typically takes 6 weeks, whereas equipment installation, testing and pre-operational systems optimization takes an additional 6 weeks prior to commencing system operation
- In general, it takes between 18 and 24 months for Nextel to roll out initial operational capability in a given service area

## Network Overview...Architecture

### **UNLIKE MOST SMR OPERATORS THAT TYPICALLY USE A SINGLE LARGE, POWERFUL TRANSMITTER TO COVER A GEOGRAPHICAL AREA, NEXTEL USES A CELLULAR-LIKE NETWORK ARCHITECTURE**

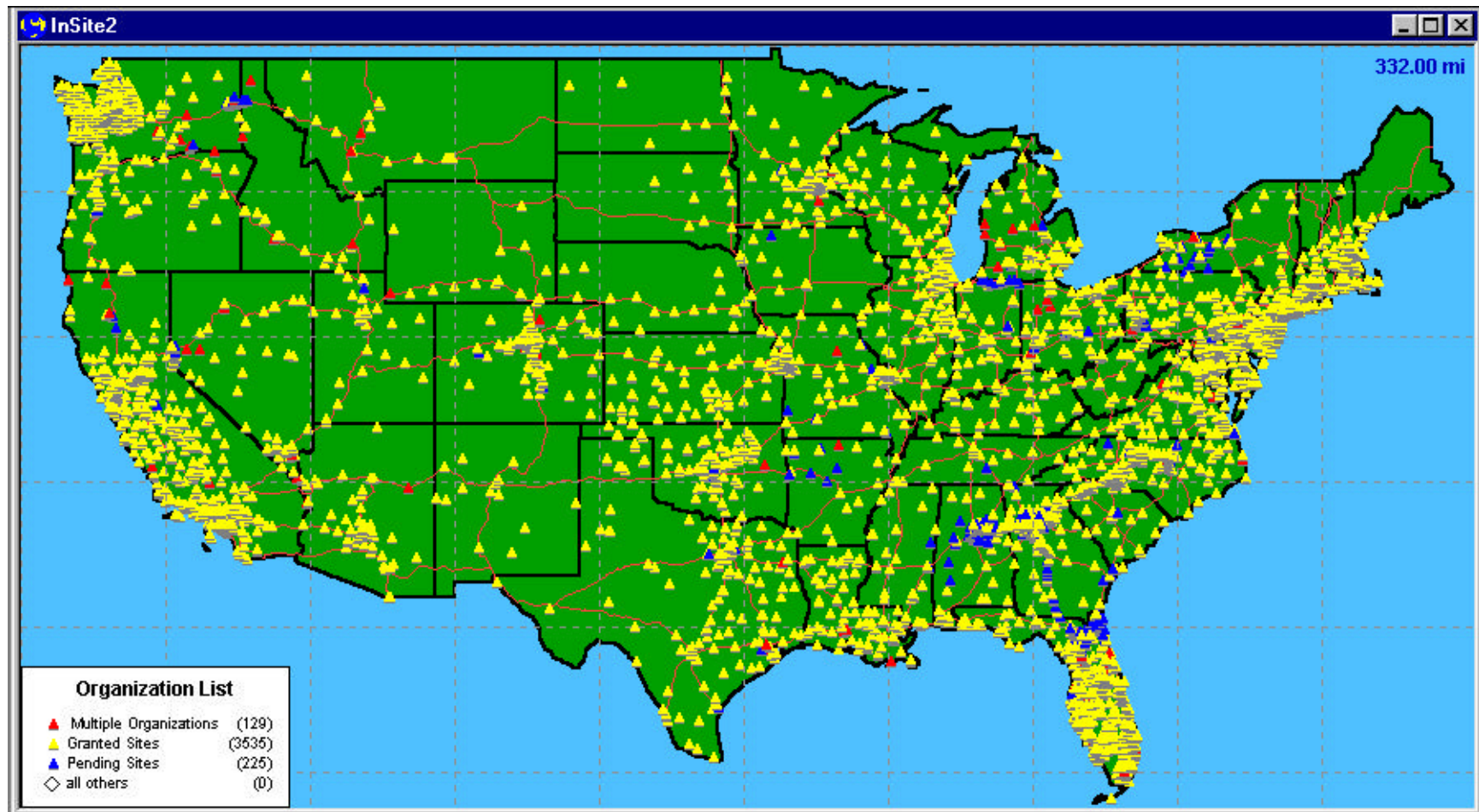
- This type of architecture, illustrated on the facing page, places transmitters/receivers (transceivers) in numerous small “cells” within an area
  - The transceivers are controlled by a central processor, or switch, so that a Nextel subscriber can move between cells or frequencies and still maintain a conversation (i.e., handoff capability)
  - Cell sites typically have a radius of 2–10 miles
- This architecture enables Nextel to reuse the same frequencies repeatedly within a single service area
  - Since each cell is designed to use radio frequencies only within its boundaries, the same frequencies can be reused in other cells that are not far away
  - The reuse of frequency allows Nextel to handle a large number of simultaneous calls with a limited number of frequencies available
  - The hexagonal arrangement helps ensure enough separation exists between any two cells using the same frequencies so that interference does not occur
- The number of transceivers or channels in a given cell depends on the traffic that cell is expected to handle
- As traffic grows in the system, additional channels and cells can be added until all the available spectrum is in service
  - Capacity can be further enhanced by splitting a cell into two or more smaller cells
  - As the size of cells are reduced, the same frequencies can be used in more cells, which in turn means more subscribers can be supported by the system
  - A Nextel’s cell site can accommodate a maximum of 24 channels if it is a sectored site or 20 channels if it is an omni-directional site configuration
- Following commencement of system operations in a selected market, Nextel expects to continually add new sites to improve coverage and capacity

## Network Overview...Coverage



# NEXTEL HAS APPROXIMATELY 4000 CELL SITES CONSTRUCTED AND IN OPERATION IN ITS DIGITAL NETWORK

## NEXTEL CELL SITE LOCATIONS



Source: April 1998 PerCon/FCC Database

**NEXTEL'S NETWORKS ARE ENGINEERED WITH GRADES OF SERVICE COMPARABLE TO OTHER COMMERCIAL WIRELESS SERVICES AND ARE COMPRISED OF FAULT TOLERANT EQUIPMENT**

- Reliability reflects the ability of a user to access a service and complete a call; it is primarily determined by the capacity of the system and the performance of the network equipment
- Capacity planning is driven by demand characteristics and market information
  - Total number of subscribers forecasted for the network
  - Monthly minutes of usage per subscriber
  - Traffic intensity per subscriber
- Allocating demand is based on weighting certain demographic data within the service area
  - Population density
  - Income
  - Highway traffic intensity
  - Employment characteristics
- Based on an evaluation of this information, Nextel determines the number of channels required per cell and grade of service, which is the probability that a call will be blocked
  - The grade of service for Nextel's cellular service is 2 percent, which is consistent with other wireless service providers
  - The grade of service for the Direct Connect service is 5 percent
- The reliability of Nextel's network is also a function of the performance of its fixed network equipment
  - Critical controlling and switching equipment is designed so that failure of a critical component results in the transfer of functionality to redundant components
  - However, this transfer usually takes place within a piece of equipment and would not remedy the problems resulting from a piece of equipment that is physically damaged or destroyed

**THE IDEN SYSTEM DOES NOT SUPPORT ENCRYPTION BUT HAS ATTRIBUTES THAT FOSTER LIMITED PRIVACY**

- IDEN is a digital system that uses time division multiple access (TDMA) multiplexing technology for voice transmission
  - TDMA divides a voice channel into timeslots, each 15 milliseconds long
  - IDEN uses six-timeslot TDMA technology for two-way dispatch service and three-timeslot TDMA technology for mobile telephone interconnection
  - A person trying to intercept a call would need to consistently identify the timeslot of a particular communication
- IDEN also uses a compression algorithm for digitally encoding/decoding speech, so even if a user stream could be identified, the actual voice component of the transmission would still need to be decoded from the encoding using the compression algorithm
- Nextel does not use the Cellular Message Encryption Algorithm (CMEA)—the algorithm used to encode the digits depressed on many wireless key pads (and which was broken in March 1998)

## **USING AUTHENTICATION TECHNIQUES, THE NEXTEL NETWORK DETERS CLONING AND UNAUTHORIZED ACCESS TO THE SYSTEM**

- In first generation cellular systems, mobile telephone numbers and serial numbers were often stolen from the airwaves and programmed into “cloned” handsets, allowing unauthorized service at the expense of actual users
- In analog conventional radio systems, radio users can select a channel, listen to group conversations, and gain unauthorized use of channels and repeater systems
- Each Nextel switch uses an authentication procedure to verify mobile station registration preventing cloned handsets from using service or gaining access to talk group conversations
  - Each handset has an authentication key assigned at subscription time and also stored at the switch authentication center (AC)
  - When a mobile station is powered on or roaming, the AC sends an authentication request with a random number to the mobile station
  - The mobile station uses the key to generate and send a response back to the AC; if the response matches the AC calculation, service is allowed
- The authentication process eliminates the need to send private identification data over the airwaves where it can be stolen and used to clone handsets
- To prevent transmitting user IDs over the air during interconnect call processing, a mobile station is assigned a temporary ID number each time it registers or roams; this process reduces the ability to pirate IDs for fraudulent access and eavesdrop conversations

**IN ADDITION TO THE SERVICES AND FEATURES DESCRIBES SO FAR, THE iDEN SYSTEM SUPPORTS AN OPTIONAL ADVANCED FEATURE SET THAT NEXTEL HAS NOT DEPLOYED**

- The advanced iDEN feature set includes 16 different levels of priority access, emergency call, status message, isolated site operation, and talk group scan
- Priority access enables the system operator to grant selected users access to a congested cell site presumably based on their relative importance to emergency or disaster relief
  - The FCC has issued a notice of proposed rulemaking regarding the establishment of rules and requirements for priority access service for public safety providers operating on commercial wireless services
  - Nextel filed comments with the FCC supporting priority access on a voluntary basis
    - Nextel argued that mandating carriers to provide priority access may not be necessary in light of the additional 24 MHz of public safety spectrum
    - Priority access has liability, network configuration, cost recovery, and cost of services issues that would need to be addressed by the FCC
- Emergency call is a feature often found on private LMR systems that allows a user to send an emergency alert that preempts existing calls and call requests
- Status Message enables a subscriber unit to transmit predefined operating status codes to a wireless dispatch console
- Isolated Site Operation is a feature that allows a dispatch call to continue even if connectivity between the site and the switching center is lost
- Talk Group Scan enables a subscriber to monitor and talk to as many as four talk groups; a subscriber can talk to only one talk group at a time on the current Nextel network; Nextel is considering providing inter-service area Direct Connect service and talk-around capable phones

#### **IV. PUBLIC SAFETY COMMUNITY'S USE OF NEXTEL SERVICES**

Public Safety Community's Use of Nextel Services...

**THIS SECTION WILL FOCUS ON THE PUBLIC SAFETY COMMUNITY'S USE OF NEXTEL SERVICES TO FULFILL THEIR MISSIONS**

Nextel is currently supporting a wide range of public safety-related missions and organizations

Representatives from various federal and local public safety organizations were interviewed over a two month period about their use of Nextel services

This section will provide an overview of the way these organization are using the service

- What missions are being supported by Nextel
- What are the users perceptions about the service and equipment

To maintain the anonymity of the organizations, no names or cities will be used in this section

References to multiple federal agencies are differentiated by the names Federal Agency A, Federal Agency B, and Federal Agency C etc.

## Public Safety Community's Use of Nextel Services...

### **FEDERAL LAW ENFORCEMENT AGENCY "A" HAS BEEN USING NEXTEL SERVICES SINCE OCTOBER 1997 TO SUPPORT BOTH ADMINISTRATIVE AND OPERATIONAL COMMUNICATIONS**

The agency was searching for an alternative to bulky and conspicuous private LMR radios

- 67 model i370 phones with car kits were acquired for \$224 a piece
- The initial service package for each unit included 100 cellular minutes and 250 Direct Connect minutes for \$55 per month, but the package was later changed to zero (0) cellular minutes and 500 Direct Connect minutes for \$50 per month

There have been instances of holes in coverage and inadequate service area coverage; system congestion has occurred during cellular call attempts

The services are used on a daily basis, but Direct Connect is the most used for surveillance, investigation, arrests, and protective details

- The handset functionality is considered excellent; digital voice quality is adequate
- 13 talkgroups are established
- Text messaging service is not used
- Private LMR radios are still available and are used when there is a problem with the coverage
- Nextel cellular service use is discouraged

The office is currently evaluating the long term viability of Nextel as a cost effective communications tool

- The Direct Connect Talkgroup feature has led to excessive bills
- The agency would prefer to use the Talk Group function more but it would be cost prohibitive
- During the first month of use, the agency exceeded its aggregate number of Direct Connect minutes by 16,000 minutes
- Users had to be educated about the consequences of the liberal use of talk groups, and the use of the Direct Connect Private Call was encouraged whenever appropriate
- The agency still has problems with keeping the Direct Connect additional charges to a minimum

## Public Safety Community's Use of Nextel Services...



**SINCE THE SPRING OF 1997, FEDERAL LAW ENFORCEMENT AGENCY “B” HAS INCREASINGLY USED NEXTEL SERVICES FOR ADMINISTRATIVE AND OPERATIONAL COMMUNICATIONS**

The office has over 250 Nextel phones that were acquired in increments during the last year

- The service package includes 75 cellular and 250 Direct Connect minutes for \$55 per user per month; this rate was later lowered to \$44
- The office has never exceeded its aggregate included minutes

Direct Connect is used daily and is the most used service for surveillance, arrests, investigations, and protective details

- Approximately 50 talk groups are established
- Private Call is used more than Group Call
- The alphanumeric paging service is not used
- Users still carry cellular phones and pagers

The coverage for the area was considered adequate and comparable to the areas cellular service

There have not been any reported incidents of congestion for the Direct Connect Service, but some incidents of network congestion for cellular calls have been reported

The entire Nextel service area was inoperable for three straight days as a result of complications encountered when Nextel added another mobile switching center to the network

The Nextel Large Account Customer Service has been very responsive to the agencies requests, although the time for the establishment of new talk groups has varied from 4 hours for 10 users to 1 week for 90 users

## Public Safety Community's Use of Nextel Services...

### **FEDERAL LAW ENFORCEMENT AGENCY "C" IS USING NEXTEL IN SEVERAL OFFICES AROUND THE COUNTRY**

A total of 50 phones are used in the several U.S. cities

- Offices have been using the service between 6 to 18 months
- The service package includes 250 Direct Connect Minutes and 90 Cellular minutes for \$50 per user per month
- Law enforcement sensitive communications involving surveillance, investigations, and arrests are made using the service

Alphanumeric messaging and Private Direct Connect services are heavily used on a daily basis

- All offices have the NextNote software package for sending text messages
- Private LMR radios still available but are not used

Users have asked Nextel to establish talk groups at times for various task forces, and Nextel has been very responsive in fulfilling the request

Users believe that Nextel has generally better coverage compared to the private LMR systems in most of the cities

There have not been any reports of system congestion for cellular or Direct Connect call attempts

- Priority access has been requested but not granted
- Nextel has stated that the company is considering implementing a priority access feature

The service is considered an interim solution until a new private LMR system is built

## Public Safety Community's Use of Nextel Services...

### **FEDERAL LAW ENFORCEMENT AGENCY "D" IS USING NEXTEL SERVICES FOR ADMINISTRATIVE COMMUNICATIONS ONLY**

The agency has been using Nextel in one U.S. city since February 1998

The agency has 40 i600 model Nextel phones configured with 9 different talk groups

Nextel services are used for administrative communications; no operational communications are transmitted over the Nextel network

The representative interviewed did not recommend the service be used for operational communications

- Reliability concerns
- Coverage concerns
- Security concerns
- No talk-around capability

Agents have experienced coverage holes in the service area

Agents were concerned with the fact that there was no audible notification that the user has lost coverage or is out of the service area; there is only a visual icon on the handset

Agents carry cellular phones and LMR radios, and the office does not anticipate Nextel replacing either communications tool

The office has had problems resolving billing issues with Nextel

- Talkgroup charges
- Office received 5 different bill statements

## **NEXTEL HAS DONATED PHONES AND SERVICES TO LOCAL PUBLIC SAFETY ORGANIZATIONS**

In one state, Nextel has helped establish program designed to increase lines of communication between citizen police volunteer groups and local police

- Nextel coordinates with the state's crime prevention association
- The company donated 50 phones and services to various communities based on need
- Communities must apply to association for phones and services
  - Sponsorship from local law enforcement agency
  - Operate in an "observe and report" manner

One county served as the testbed for the entire state

- The county is about 2000 square miles and has approximately 600,000 residents
- Seven Nextel phones are provided on a temporary basis to towns within the county
- The phones are credited for providing volunteers with a greater sense of personal security
- Police precincts and 911 dispatch center phone numbers are "speed-dialed" into the phones
- A Direct Connect talkgroup set up for the patrol is the most used function
- A local narcotics task force tested the phones and is now considering procuring more phones

A mountain search and rescue organization is also using Nextel phones to coordinate public safety organizations and volunteer groups from five counties during mountain search and rescue operations

- The service is credited for significantly improving interoperability and logistics
- The iDEN-based Nextel network offers a greater safeguard to eavesdropping compared to the conventional analog LMR system the organization uses
- A phone patch is set up between conventional analog system and a Nextel phone
- The organization is encouraging public safety organizations to procure Nextel services
- The organization has not experienced any Nextel network congestion or system failures
- Network coverage is adequate and is not a concern; there is a Nextel cell site on the nearby mountain

## Public Safety Community's Use of Nextel Services...

### **A LARGE METROPOLITAIN POLICE DEPARTMENT HAS RECENTLY STARTED USING NEXTEL SERVICES**

An intelligence unit responsible for protective services and anti-terrorism activities is using Nextel for operational and tactical communications

- The unit has between 60 to 80 Nextel phones
- Operational and administrative communications are supported by Nextel
- Officers still carry private LMR radio, cellular phone, and pager

Direct Connect dispatch and alphanumeric paging are the most used services

- Private Direct Connect is extensively used
- The unit has approximately four talk groups established

There are no reported incidents of system congestion

In general, coverage has been acceptable and not a problem, although there are mixed reports on the quality of in-building penetration

The Nextel customer service is considered exceptional

The organization is considering quadrupling the number of Nextel handsets if sufficient resources can be garnered

Users do not consider Nextel services as a replacement to private LMR system or commercial cellular service but as another communications tool

Public Safety Community Use of Nextel Services...

**A COUNTY SHERIFF'S OFFICES HAS JUST RECENTLY ACQUIRED NEXTEL SERVICES**

The department has purchased 25 phones

The service package includes unlimited Direct Connect Private Calling service and 600 minutes of cellular service for \$70 per user per month

The department intends to use the phones for administrative communications primarily and operational communications on a limited basis

Nextel network engineers met with county representatives to address coverage issues

Based on that meeting, the representatives were satisfied with the general coverage of the service area and understand that there may be some holes in coverage

Nextel representatives also addressed reliability issues and were informed that there was a possibility of system congestion and that all users should be aware and consider this in system planning and service use

## Public Safety Community's Use of Nextel Services...

### **IN GENERAL, THE PUBLIC SAFETY USERS INTERVIEWED FOR THIS REPORT WERE SATISFIED WITH THE NEXTEL SERVICES**

The reliability of the system has been good and users are aware of potential for system congestion and use private LMR systems accordingly

The Nextel handsets were considered excellent and performed well

- The handsets were easy to use and require little training
- Voice quality was clear
- The similar look of Nextel phones to cellular or PCS phones was considered to be an advantage
- Battery life was exceptional
- Some users, however, considered the PTT button too small

Coverage has been adequate or better than private systems in some service areas

- Coverage was comparable to other commercial services in some areas
- Nextel has improved coverage since many organizations first procured their phones

Customer Service was generally good

- Major Account Customer Service is very responsive to customer needs
- Nextel provided excellent training for phone use
- Nextel has been responsive for talkgroup creation for new task forces

## Public Safety Community's Use of Nextel Services...

### **THERE WERE SOME NOTEWORTHY CONCERNS WITH THE SERVICES, NETWORK AND TECHNOLOGY PERFORMANCE**

The inability to use the Direct Connect service between service areas was a common complaint

Nextel does not offer a priority access feature that would enable public safety users to communicate during network congestion

- There were instances of network congestion for cellular calls but never for Direct Connect call attempts
- Some users were concerned with the potential effects of increased subscriber growth on congestion, network performance, and reliability

Nextel phones are not talk-around capable (i.e., able to support radio-to-radio communication when out of network coverage area)

- Some public safety users and missions require talk-around capability
- Nextel representatives have told the public safety community that talk-around capable iDEN phones were being considered but no plans were definite

Some users noted the lack of in-building penetration in basements and elevators

There is potential and examples of excessive service bills through the use of Direct Connect talkgroups

- The cost of a Direct Connect call reflects the number of users on that talkgroup
- Cultural issues can contribute to the liberal use of talkgroups (e.g., traditional LMR users use talk groups liberally, and are not necessarily usage sensitive)
- This can create some difficulty in the adjustment to usage sensitive commercial dispatch service
- Memorandums of Understanding or use parameters have been set up in some instances to efficiently manage the use of the service (i.e., use Private Call versus Talkgroup)



## **V. SUMMARY AND CONCLUSIONS**

Summary and Conclusions...

**NEXTEL'S SERVICE OFFERINGS AND CONTINUED IMPLEMENTATION OF ITS BUSINESS PLAN SHOULD POSITION THE COMPANY TO BE A LONG TERM PLAYER IN THE WIRELESS MARKET**

KEY CUSTOMER SATISFACTION DRIVER	NEXTEL SERVICE ATTRIBUTES
Call Quality	<ul style="list-style-type: none"> <li>• Digital network provides high quality voice communication</li> <li>• 800 MHz has good propagation and building penetration characteristics</li> </ul>
Corporate Image: Credibility	<ul style="list-style-type: none"> <li>• National brand strategy</li> <li>• Reconfigured IDEN technology provides integrated suite of services that no other wireless carrier offers</li> <li>• Growing pains have affected timely delivery of ready-to-use phones</li> </ul>
Corporate Image: Corporate Capabilities	<ul style="list-style-type: none"> <li>• Solid management structure committed to implementing business plan</li> <li>• Established credibility on Wall Street</li> <li>• Innovative reputation</li> </ul>
Pricing Options	<ul style="list-style-type: none"> <li>• Prepackaged minutes offer simple, easy to understand pricing structure</li> <li>• Nextel is willing to "deal" with users</li> <li>• No hidden charges</li> </ul>
Customer Communications	<ul style="list-style-type: none"> <li>• Broadening direct and indirect distribution channels</li> <li>• Major Account Customer Service is responsive</li> <li>• Some growing pains in large markets</li> </ul>
Billing	<ul style="list-style-type: none"> <li>• Bill can be confusing at first, due to Direct Connect</li> <li>• Users must be cautious with the use of talkgroup Direct Connect</li> </ul>
Roaming/Coverage	<ul style="list-style-type: none"> <li>• Rapidly deploying nationwide network</li> <li>• Coverage is good and should improve over the next 3-5 years</li> <li>• Phones only work where there is a Nextel network</li> <li>• One national network, so no roaming agreements</li> </ul>
Cost of Roaming	<ul style="list-style-type: none"> <li>• No roaming charge is a significant differentiator</li> </ul>

Summary and Conclusions...

**PUBLIC SAFETY ORGANIZATIONS WILL NEED TO EVALUTATE THEIR SPECIFIC OR UNIQUE FUNCTIONAL COMMUNICATIONS NEEDS AND RESULTING REQUIREMENTS AGAINST NEXTEL'S SERVICE ATTRIBUTES**

MISSION	SAMPLE FUNCTIONAL COMMUNICATIONS NEEDS	RESULTING REQUIREMENTS	NEXTEL SERVICE ATTRIBUTES
<ul style="list-style-type: none"> <li>• Surveillance</li> <li>• Investigations</li> <li>• Undercover wire operations</li> <li>• Fire</li> <li>• Emergency Response</li> <li>• Border management</li> <li>• Prison operations</li> <li>• Person protection</li> <li>• Hostage operations</li> <li>• Counter-terrorism</li> <li>• Search and rescue</li> <li>• Event control</li> <li>• Community policing</li> </ul>	<ul style="list-style-type: none"> <li>• Support operations and cases throughout organizations' jurisdictions →</li> <li>• In-building and outdoor coverage →</li> <li>• Mobile communications in vehicle and on foot →</li> <li>• Ability to exchange sensitive information without interception →</li> <li>• Assured communications during emergency conditions →</li> <li>• Share information among various organizations →</li> <li>• Easy to initiate, respond to, and use →</li> <li>• Cost effective →</li> </ul>	<ul style="list-style-type: none"> <li>• Communications capabilities must be, local, regional, or national →</li> <li>• Coverage must support in-building and outdoor coverage to include urban, rural, and rough terrain →</li> <li>• Service must support officials in vehicles and on foot →</li> <li>• Communications must be secure →</li> <li>• Service must ensure consistently reliable communications, particularly during large scale emergencies →</li> <li>• Service must provide coordination for interoperable communications →</li> <li>• Handsets must provide quick call set-up, be easy to use, and support hands-free accessories →</li> <li>• Service must support mission within budget constraints →</li> </ul>	<ul style="list-style-type: none"> <li>• Building national network that will eventually support inter-service area dispatch</li> <li>• 800 MHz, digital iDEN network</li> <li>• Cellular-like configuration supports conversation hand-off</li> <li>• Digital TDMA, no encryption</li> <li>• Spectrally efficient technology, at least 10MHz of spectrum in most service areas, no priority access</li> <li>• Direct Connect talkgroups</li> <li>• Compact highly functional and easy to use handset, push-to-talk operation</li> <li>• Pre-packaged service plans, additional minutes charged, no roaming fee</li> </ul>

## Summary and Conclusions...

### **THERE ARE A NUMBER OF FACTORS THAT WILL LIKELY LEAD THE PUBLIC SAFETY COMMUNITY TO INCREASE ITS USE OF NEXTEL OVER THE NEXT SEVERAL YEARS**

- Nextel will have extensive nationwide availability and coverage within 3 to 5 years
- The company plans to continue to promote a national brand image and develop distribution channels to market and deliver its services
- Nextel is interested in gaining the public safety community as customers
  - Nextel actively markets the public safety community
  - In December 1997, Nextel filed comments with the FCC supporting the ability of commercial service providers to provide public safety communication services on the newly allocated 24 MHz of public safety spectrum
  - By donating phones to local users, Nextel is increasing its visibility and peaking interest within the public safety community
- Nextel offers an integrated package of services generally attractive to public safety users
  - Digital Cellular
  - Direct Connect push-to-talk dispatch similar to private LMR networks
  - Alphanumeric text messaging
  - Data (future)
- Nextel is considering adding inter-service area Direct Connect, talk-around capable phones, and priority access which would make its services even more attractive to the public safety community
- No other commercial service provider offers a comparable integrated service package on a national and international scale

## Summary and Conclusions...

### **ORGANIZATIONS SHOULD CONSIDER SEVERAL ISSUES WHEN EVALUATING NEXTEL SERVICES**

- Organizations must consider the costs of using Nextel services
  - Versus other commercial services
  - Versus upgrading or replacing private LMR infrastructure
- Security considerations will determine the extent to which Nextel services are used by individual public safety organizations
  - The Nextel network does not support encryption
  - Digital TDMA has privacy attributes but should not be considered completely secure
- Commercial service customers of the same provider are competing equities for limited resources, so unless priority access is available to public safety users, there will always be a reliability concern
  - Nextel networks are designed with grades of service similar to other commercial wireless networks which experience congestion
    - 2 percent cellular GOS
    - 5 percent dispatch GOS
  - The effect of large subscriber growth on system capacity is unknown
- As a customer, a public safety user will have little control over network performance and maintenance; there have been instances of prolonged network outages
- Despite aggressive deployment of Nextel's digital network, the network is still in its early stage and lacks the coverage of more mature commercial wireless networks, however, this should be resolved over the next 3 to 5 years

## APPENDIX A: NETWORK ARCHITECTURE